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VII Congreso sobre Materiales Multifuncionales

18 y 19 de mayo de 2026

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	Sunday	Monday	Tuesday
9:00-9:20		**Opening ceremony**	**Plenary 3** Silvia Cabrera Herranz
9:20-9:40		**Plenary 1** Thomas Devic	
9:40-10:00			O10 Alberto Moreno Fernández
10:00-10:20		O1 Nerea Menargues Sanz	O11 Francisco Manuel García Salas
10:20-10:40		O2 Miriam Abán Alfaro	O12 Aday Herrera Owono
10:40-11:00		O3 María Devesa García	O13 Verónica Luque Agudo
11:00-11:30		**Coffee break**	
11:30-12:00		**Invited Talk 1** Catalina Biglione	**Invited Talk 2** Xabier Lopez de Pariza
12:00-12:20		O4 Laura Filomena Mazzei	O14 Ruperto Bermejo Román
12:20-12:40		O5 Miguel A. Ramos-Docampo	O15 Jesús Naranjo
12:40-13:00		O6 Hanae Boulehjour	O16 Francisco Antonio Guerrero Román
13:00-13:20		O7 A. Rabdel Ruiz Salvador	O17 Christian De los Ríos Quiñones
13:20-14:00		Flash Presentations F1 – F5	O18 Beatriz Alba Sangrós
14:00-16:00		**Lunch break**	F1 – José Manuel Zubeldia Gutiérrez F2 – Carmen López León F3 – Aitor Uriarte Erroz F4 –Marisa Muñoz Morales F5 – Maialen Terceño Carrillo F6 – Eleonora Iannuzzi F7 – Pablo Guerrero García F8 – Maialen Guerra Mantzizidor
16:00-16:40		**Plenary 2** David González Rodríguez	
16:40-17:00		O8 María del Mar Noblejas López	
17:00-17:20		O9 Iván Torres Moya	
17:20-17:50		**Coffee break**	
17:50-18:10		Flash Presentations F6 – F8	
20:00-22:00	**Wellcome Cocktail**		

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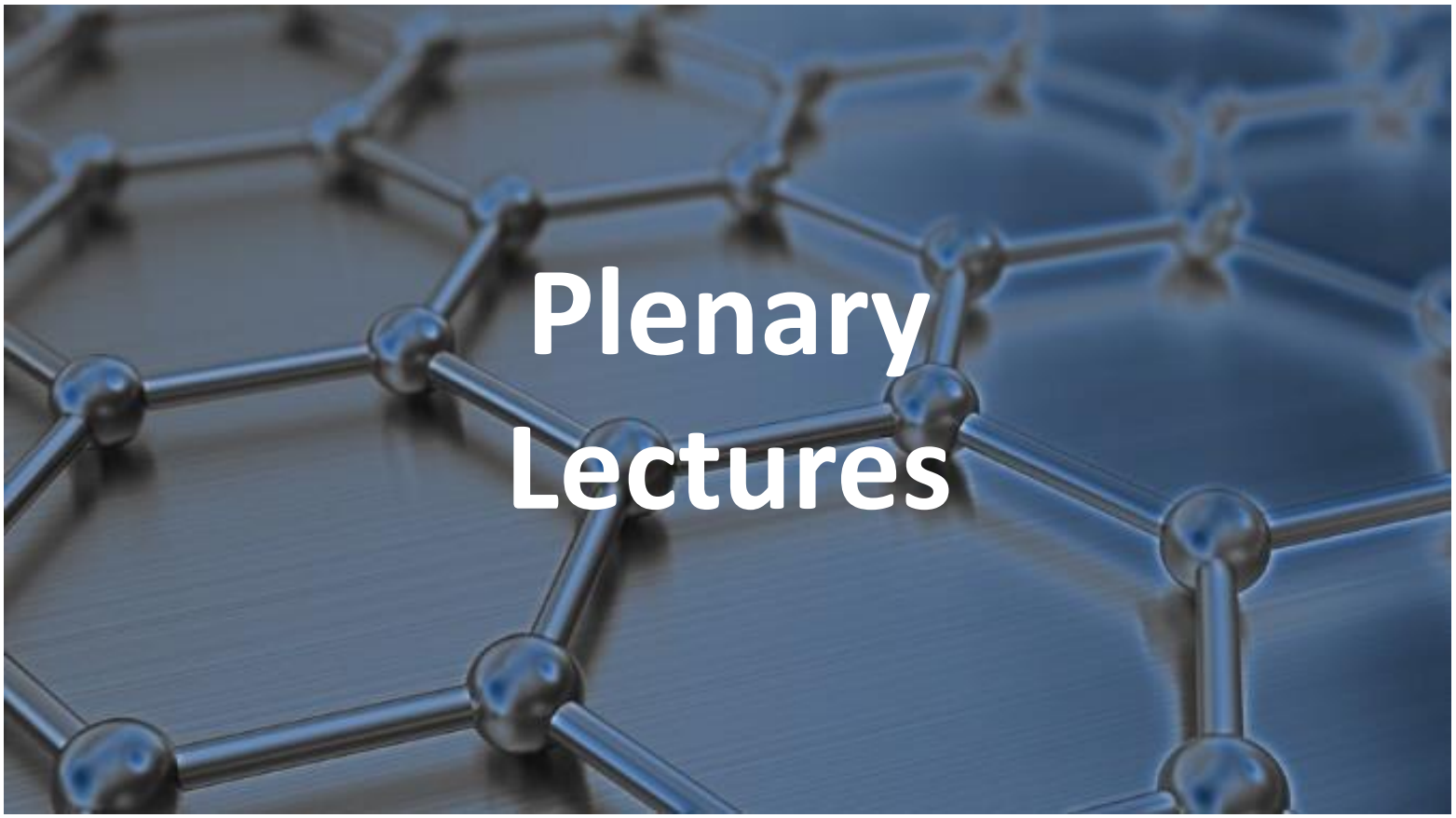

Plenary Lectures

P1 – METAL ORGANIC FRAMEWORKS (MOFs): WHY LEAVING CARBOXYLATES FOR OTHER COMPLEXING GROUPS?

Thomas Devic[1]

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Crystalline porous coordination polymers, or Metal-Organic Frameworks (MOFs), are constructed from inorganic oxoclusters linked together by polytopic organic ligands to form pores of various sizes and shapes. Although the field is largely dominated by carboxylate ligands (e.g., HKUST-1, MIL-100, UiO-66) and azolates (ZIF-8, CALF-20), the use of alternative complexing functions is a way to broaden the range of compositions and properties that can be achieved. We are particularly interested in the use of polyphenolate ligands (catecholate, gallate), potentially bio-sourced, and their sulfur-containing analogues.

We will first show how the physicochemical characteristics of these alternative ligands (charge, pKa, hard/soft character) affect both the synthesis and the crystallochemistry of the derived MOFs, and then present the relationships between the composition, structure, and properties of these MOFs, particularly in the field of electrochemical energy storage,[1] gas capture,[2] and post-synthetic functionalization.[3]

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P2 – NONCOVALENT SYNTHESIS: FROM CHEMICALLY PROGRAMMED MOLECULES TO COMPLEX, SELF-ORGANIZED MATTER

David Gonzalez Rodriguez[1,2]

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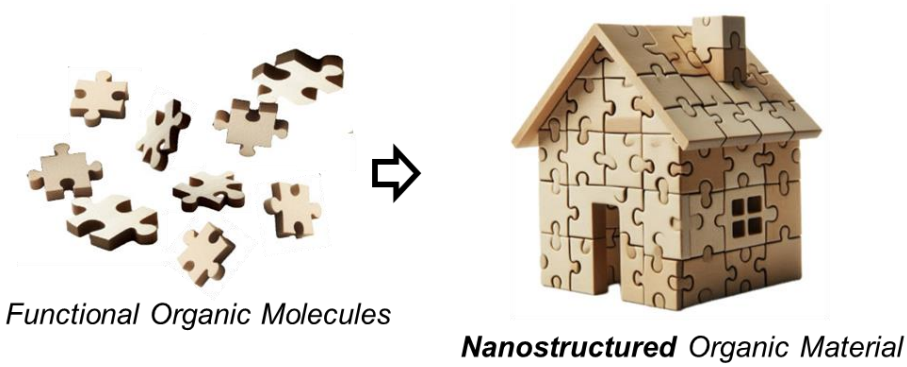
The *Nanostructured Molecular Systems and Materials* (*MSMn*) group's main objective is to improve or create new functions in organic systems and materials by rationally ordering molecules at the nanoscale using the tools of supramolecular chemistry. The group a) designs and b) synthesizes new functional molecules, from biologically relevant molecules to π-conjugated dyes or polymers, c) programs them with specific supramolecular information in order to guide their assembly into a given nanostructure, and d) studies how the system properties relate to molecular structure and supramolecular architecture. In collaboration with several groups of chemical physicists and molecular biologists, the group wants to explore unconventional and exciting applications of nanostructured systems and materials in diverse multidisciplinary areas, such as organic optoelectronics, molecular recognition and catalysis, advanced materials or biomedicine. This talk is hence focused on *Noncovalent Synthesis*. I will show how we can go from relatively simple chemically programmed molecules to complex, precisely defined tubular nanostructures endowed with custom-tailored pores, by coupling two cooperative self-assembly processes of different hierarchy and acting in orthogonal directions.[1],[2]



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Acknowledgements

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P3 – MATERIAL DESIGN STRATEGIES FOR HETEROGENEOUS PHOTOCATALYSIS

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The rational design of heterogeneous photocatalysts requires precise control over the incorporation, distribution, and microenvironment of the photoactive units in solid matrices. Based on our previous work for the development of novel photocatalytic systems,[1] we have established different and complementary material platforms containing the highly reducing organic photocatalyst 10-phenylphenothiazine (PTH) for illustrating how different material architectures modulate photophysical properties and catalytic performance. First, the direct covalent attachment of PTH into single-walled carbon nanotubes was developed.[2] By tuning the degree of functionalization, an optimal hybrid material is obtained, where efficient charge separation and electron transport through the nanotube scaffold lead to photocatalytic debromination rates surpassing those of homogeneous PTH, while ensuring recyclability and avoiding leaching. On another hand, PTH immobilization inside mesoporous silica supports provides water-compatible heterogeneous photocatalysts for atom transfer radical addition reactions.[3] Confinement within well-defined mesopores enhances photocatalytic efficiency in aqueous media and allows substrate selectivity to be modulated by pore size and local hydrophobicity, highlighting the role of nanoconfinement in photocatalysis. Finally, a cyclobutane-linked covalent organic polymer is synthesized through a light-induced [2+2] cycloaddition, where PTH acts simultaneously as photocatalyst and structural building block.[4] Controlled incorporation of PTH reveals a non-linear relationship between catalyst loading and activity and the optimal polymer promotes both dehalogenation and C-C/C-heteroatom bond-forming reactions.

Overall, these studies demonstrate how material design, from conductive carbon nanostructures to porous inorganic supports and polymeric networks, critically governs photocatalytic activity, selectivity, and stability, providing general guidelines for the development of advanced heterogeneous photocatalysts.

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Acknowledgements

Financial support was provided by the Spanish Government (PID2021-122299NB-I00, TED2021-129999B-C32, PID2024-155520NB-I00) and Comunidad de Madrid (Y2020/NMT-6469).

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Invited Talks

I1 – MOF–NANOPARTICLE HYBRIDS AS MULTIMATERIAL PLATFORMS FOR FUNCTIONAL INTEGRATION

Catalina Biglione[1], Yolanda Pérez[1], Patricia Horcajada[1]

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The development of functional multimaterials requires strategies that enable the integration of complementary properties within a single, tunable platform. In this context, composites based on metal–organic frameworks (MOFs) and inorganic nanoparticles (iNPs) have emerged as highly promising systems, combining the structural versatility and porosity of MOFs with the diverse physicochemical functionalities of nanoscale inorganic components.[1] MOFs provide an ideal scaffold due to their high surface area, chemical tunability, and well-defined porous architecture, while iNPs contribute size-dependent optical, magnetic, electronic, and catalytic properties. The resulting hybrids enable the rational design of multifunctional materials in which adsorption, catalysis, and stimulus-responsive behavior can be simultaneously engineered.[2] Such capabilities are particularly relevant for applications ranging from environmental remediation and CO_2 capture to catalysis and biomedicine.

Within this framework, we have developed a synthetic toolbox for the preparation of MOF-iNP composites based on different porous and thermally robust MOFs (*e.g*. SU-101, MIL-88B, MOF-808, MIL-125-NH_2, DUT-5) combined with a variety of inorganic nanoparticles (*e.g.* magnetic nanoparticles, Ag, Au, Cu). [3] The incorporation of iNPs is achieved through *in situ* formation or (photo)reduction within the MOF structure, enabling controlled nucleation and growth under confinement. The resulting composites exhibit homogeneous nanoparticle dispersion with sizes in the 1–3 nm range, while preserving the structural integrity and thermal stability of the host frameworks (up to 300-450 °C, depending on the MOF). This controlled integration of multiple components leads to materials with enhanced and tunable performance across different application domains.

Overall, this work highlights MOF-iNP composites as a versatile multimaterial platform, where the interplay between framework and nanoparticle components enables the design of next-generation functional materials.

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Acknowledgements

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I2 – SUSTAINABILITY ASPECTS IN VAT PHOTOPOLYMERIZATION; FROM RECYCLABLE RESINS TO PSEUDOTHERMOPLASTIC MATERIALS

Xabier Lopez de Pariza[1], Oihane Varela[1], Jon Ayestaran[1], Timothy E. Long[2,3], Haritz Sardon[1]

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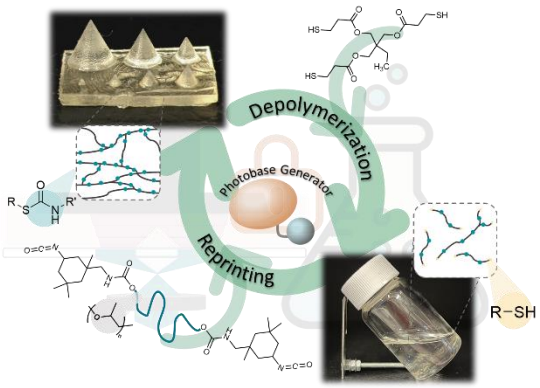
Additive manufacturing (AM), widely known as 3D printing, has become an essential and versatile platform for producing complex and customized structures. Its seamless design-to-manufacture process has revolutionized a myriad of industries beyond rapid prototyping and personalized production. Among the various polymer-based AM technologies, vat photopolymerization (VPP) has gained increasing attention as an advanced processing technique, offering superior surface finish, feature resolution, accuracy, and speed, making it a key driver of innovation in high-tech manufacturing. VPP process rely on the rapid solidification of low-viscosity liquid resins through light irradiation. This process is typically enabled by fast photopolymerization chemistries, such as free radical polymerization of (meth)acrylates or cationic polymerization of epoxides, leading to the development of materials with excellent thermal and chemical resistance, but also resulting in scarce light processable polymer families which generally produce highly crosslinked non-reprocessable and non-recyclable products, reinforcing a non-circular, linear economy model that raises major environmental concerns. Besides, the requirements for low viscosity resins limits the use of high molecular weight precursors limiting the attainable mechanical performance of printed parts.



In this talk, I will share our latest advances in the field of sustainable VPP. First, I will discuss the use of photobase generator catalysed systems to yield recyclable and reprintable thiol-isocyanate resins as a way of increasing the circularity of the VPP process [1]. Besides, I will introduce the concept of pseudothermoplastic printing which utilizes recently developed latex printing method to yield high performance materials with inherit recyclability due to their predominantly thermoplastic character[2].

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Oral Communications

O1 – TUNING WATER INTRUSION-EXTRUSION IN ZIFs VIA LINKER-CONTROLLED FLEXIBILITY

Nerea Menargues-Sanz[1], Luis León-Alcaide[2], Eder Amayuelas[3], Yaroslav Grosu[3], Guillermo Mínguez Espallargas[1],

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Zeolitic Imidazolate Frameworks (ZIFs), a subclass of Metal-Organic Frameworks (MOFs), have attracted significant attention due to their high surface areas, chemical and thermal stability, and remarkable adsorption properties. Among them, ZIF-8 ($Zn(mim)_2$) is one of the most extensively studied systems, composed of Zn^{2+} ions tetrahedrally coordinated to 2-methylimidazolate (mim) linkers [1]. A distinctive feature of ZIF-8 is its gate-opening or swing effect, arising from the rotational flexibility of the imidazolate linkers around the pore apertures [2], which strongly influences its adsorption and separation performance. More recently, increasing attention has been devoted to the intrusion-extrusion behaviour of water in such hydrophobic nanoporous frameworks, due to its potential applications in mechanical energy storage and dissipation [3]. In these systems, water intrudes into the pores only above a threshold pressure, and the resulting pressure-volume curves can exhibit molecular spring, shock absorber, or bumper behaviour, depending on the degree of hysteresis, which is governed by host-guest interactions and framework dynamics.

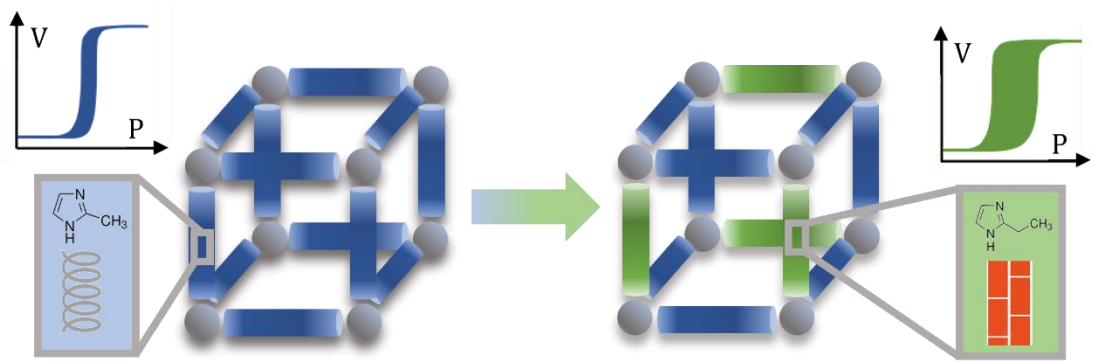

Figure 1. Overview of the approach used in this work.

Herein, we use a solvent-free synthetic strategy previously implemented by our group [4] to prepare a series of mixed-linker ZIFs with general formula $Zn(eim)_x(mim)_{2-x}$, where the progressive incorporation of the bulkier 2-ethylimidazolate (eim) linker enables fine-tuning of framework flexibility. This approach provides direct control over the water intrusion-extrusion response, establishing a clear relationship between linker composition, structural dynamics, and energy dissipation behaviour.

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O2 – METAL-ORGANIC FRAMEWORKS AS SUSTAINABLE PLATFORMS FOR THE CONTROLLED RELEASE OF BIOAGROCHEMICALS

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Population growth is rising the demand for food production. In this context, the use of agrochemicals is essential for controlling pests that can affect agricultural production (insects, fungi, weeds, etc.). However, the extensive use of these agrochemicals carries associated risks, such as water, air and soil contamination, or adverse effects on human and animal health, highlighting the need to look for more sustainable and safer alternatives.[1]

Here, we propose the use of metal-organic frameworks (MOFs), a type of porous coordination polymers formed by metal cations or clusters linked by organic polycomplexant ligands, as non-innocent carriers for the controlled release of biomolecules to act as agrochemicals in crops. Thus, we selected the highly robust and porous Zn bipyrazolate MOF, ZnBDP ($[ZnC_{12}H_8N_4]$, specific surface area, S_{BET}, ≈ 2000 m^2/g; square channels of 1.1 nm) due to the well-known antifungal and antibacterial properties of the constitutive cation, the Zn^{2+}.[2] Additionally, the natural essential oil eugenol, again with remarkable antifungal and antimicrobial activities,[3] was successfully encapsulated within the MOF porosity using a vapour phase methodology, reaching important active cargoes of 20 wt.%. Eugenol was slowly and progressively released in water (100% in 3.5 months), maintaining MOF's crystallinity and with just a 2% of linker leaching. Also, *in vitro* tests demonstrated both biosafety and antifungal and antibacterial activity against various strains. Finally, its activity was evaluated in tomato plants infected with *Fusarium oxysporum f. sp. Lycopersici*, revealing a fungistatic effect and demonstrating its potential for treating fungal infections in plants.

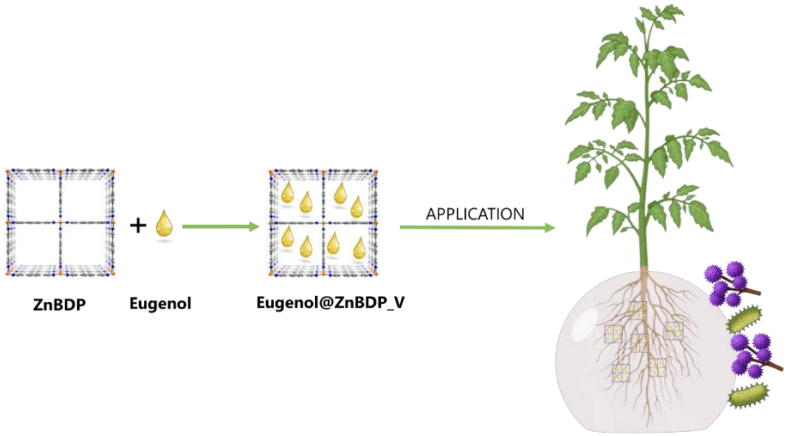

Figure 1. Scheme for the encapsulation of eugenol and its application in crop protection

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Acknowledgements

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O3 – MULTIFUNCTIONAL COORDINATION POLYMERS BASED ON AGROCHEMICAL LIGANDS: EXPLORING HERBICIDAL ACTIVITY, MAGNETIC PROPERTIES, AND LUMINESCENCE

María Devesa-García[1], Hanae Boulehjour[1,2], MCarmen Contreras[3], Sara Rojas[3], Javier Cepeda[1], Andoni Zabala-Lekuona[1]

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Lanthanide-based coordination compounds have attracted considerable interest due to their potential as multifunctional materials combining magnetic and luminescent properties. In this work, several glyphosine-based coordination complexes were synthesized following previously reported strategies[1,2], with particular emphasis on herbicidal activity, single-molecule magnet (SMM) behaviour, and luminescence. The herbicidal activity of several synthesized complexes was evaluated, with only compound **8-Mg** showing significant activity compared to the other complexes, positioning it as a potential AgroMOF candidate for future applications. Two compounds exhibiting SMM behaviour, along with their magnetically diluted analogues, were obtained. The diluted systems, **6-Y_{Dy}** and **7-Y_{Er}**, display distinct magnetic relaxation mechanisms: an Orbach process for **6-Y_{Dy}** (U_{eff} = 56 K) and a combination of Raman and quantum tunnelling processes for **7-Y_{Er}** (C = 3.081 $s^{-1}K^{-n}$, n = 7.212, τ_{QTM} = 9.6 × 10^{-4} s). In addition, two luminescent compounds, **2-Eu** and **3-Tb**, were successfully synthesized and their emission properties were studied at room temperature and at 15 K. **2-Eu** exhibits a quantum yield of approximately 20 %, while **3-Tb** shows quantum yields between 23% and 37%, highlighting the excitation-dependent luminescent behaviour of both systems. These results demonstrate the versatility of lanthanide-based systems as multifunctional materials with potential applications in magnetism and photonics.

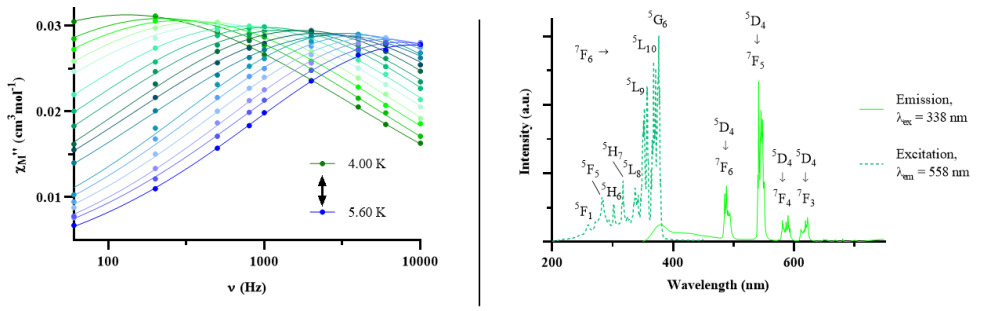

Figure 1. Left: Frequency dependence of the out-of-phase susceptibility of compound **6-Y_{Dy}**, illustrating its SMM behaviour. Right: Excitation and emission spectra of compound **3-Tb** at 15 K, highlighting its luminescent properties.

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O4 – CHIRAL POLYMERS BASED ON LANTHANIDE COMPLEXES: POLYMERIZATION EFFECTS ON MAGNETIC AND LUMINESCENT PROPERTIES

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Our research group focuses on the study of lanthanide-based coordination compounds, with particular interest in their magnetic and luminescent properties. Depending on the choice of metal ion and ligands, these systems can exhibit single-molecule magnet (SMM) behavior, as well as narrow, high-purity emission bands.[1,2] Building on previous results from our group, where chirality was successfully incorporated into monomeric bis(ZnLn) complexes,[3] we further investigated how this structural feature influences both magnetic behavior and luminescence, leading to circularly polarized luminescence (CPL). The ability to polymerize these chiral molecular systems through a variety of spacers then raised a fundamental question: what happens when chiral units are ordered along a single spatial dimension?

To address this, we present a study on the effect of polymerization on the magnetic and luminescent properties of chiral bis(ZnLn) complexes, where Ln are Tb^{III} and Dy^{III}. Starting from our monomeric reference compound, that exhibits both SMM behavior and CPL, a series of polymeric analogues are planned to be synthesized by systematically varying the spacer length and carbon chain architecture.

Our preliminary results show that extending chirality along one dimension not only preserves SMM and CPL activity, but in certain compounds actively enhances both. This work thus establishes a promising strategy for the rational design of multifunctional molecular materials with potential applications in molecular information storage.

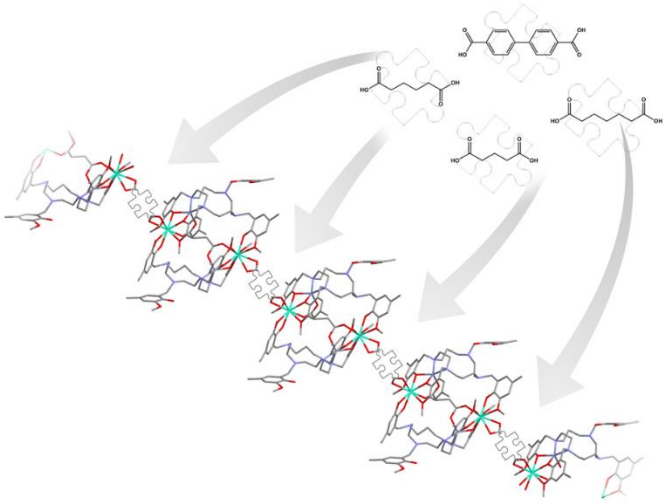

Figure 1. Polymer crystal structure with different spacer molecules.

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O5 – DIRECT COLLOIDAL SYNTHESIS OF MICROMETRIC CHIRAL GOLD STRUCTURES

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Chirality is an intrinsic characteristic of natural systems that spans from the macroscopic scale to the nanoscale. This feature of matter determines the properties, characteristics, and functions of numerous materials. Although this concept has been widely recognized in biological systems and extensively used in pharmacology, it is currently emerging with great strength in the field of inorganic nanomaterials.[1] Chiral nanomaterials present great potential to drive advances in catalysis, sensing, and optical technologies. However, to date, the reported chiral materials have been mainly limited to the nanometer scale, and their synthesis methods are often laborious and low-yield.

In this work, we present a completely new one-step method to produce chiral, enantiopure, and optically active gold structures with micrometer-scale lengths and nanometer-scale widths. This approach allows precise control over the topology of the material and its chirality. Furthermore, these structures enable the guidance of cell alignment and growth patterning.[2]

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O6 – ASYMMETRIC DILANTHANIDE MOLECULES AS PLATFORMS FOR QUBITS

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In the quest to obtain robust qubits to implement quantum computing, molecular spins are exciting candidates due to the reproducibility and versatility offered by coordination chemistry – yet, the figures of merit of the available compounds fade when compared to more established approaches such as those based on quantum dots[1] or trapped ions[2]. Thus, novel molecular systems are in high demand to help advance the field. In this context, dilanthanide molecules are promising candidates[3] as lanthanide ions possess large electron spins and orbital momenta leading to a strong spin-orbit coupling resulting in the splitting of the electronic levels, which can serve as the basis for qubit states. Furthermore, adding an interaction between qubits has been shown to be an effective way to implement quantum gates in similar compounds[3].

In this project, an asymmetric ligand was synthesized offering two distinct coordination pockets that differ in size and heteroatoms to selectively host different lanthanide ions. To assess the validity of the proposed methodology, the synthesis was first performed using diamagnetic lanthanide ions, which led to the obtention of Lanthanum(III) mononuclear compounds, characterized by NMR and single crystal XRD.

Following these results, the same reactions were carried out with the paramagnetic Cerium(III) ion, yielding analogous mononuclear compounds. The difficulties encountered in the attempts to obtain dinuclear complexes with the first ligand prompted a modification of the ligand framework to address possible affinity and size mismatches. Introduction of oxygen atoms in the second coordination pocket enabled the formation of homodinuclear compounds (**Figure 1**). Current efforts are focused on employing newly designed ligands and investigating solvent effects to promote the formation of heterodinuclear complexes, with the ultimate goal of characterizing their electronic structure using magnetometry and quantum chemical methods.

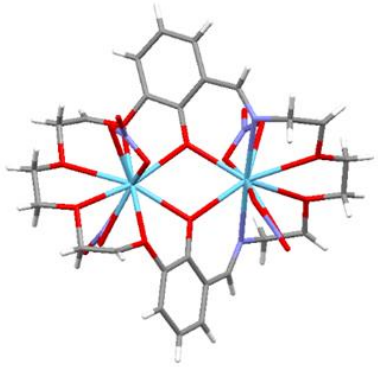

Figure 1. Crystal structure of the homodinuclear compound containing the Lanthanum(III) ion measured by single crystal XRD.
H: white, C: grey, O: red, N: dark blue, La(III): light blue.

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O7 – CRYSTAL ENGINEERING OF FUNCTIONAL ZIFs FOR PHOTO-ACTIVATED WATER PURIFICATION

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We present here recent crystal-engineering based developments in ZIFs for water decontamination and disinfection. Using a biomimetic approach, we design a MOF exhibiting hypervalent iron that shows unusual photocatalytic behavior not mediated by hydroxyl radicals [1]. DFT calculations have been conducted to model both the atomic and electronic structure of the material. Band gap engineering has been implemented by the use of multivariate ZIF components, in both metal centers and ligands to favor visible light decontamination and disinfection of water. Using mechanochemistry, easily accessible routes have been exploited for larger scale MOFs preparation to be in line with sustainable synthesis]2]. Encapsulating C60 by mechanochemical synthesis has allowed modulating the electronic states of an otherwise photocatalytic poor activity ZIF [3]. The resulting confinement has imprinted large photocatalytic disinfection capacity to the material, removing antibiotic resistance bacteria and bacteriophage P22.

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O8 – SELF-FLUORESCENT CARVONE-DERIVED POLYESTERS ENABLE CDK9-TARGETED PROTAC NANOTHERANOSTICS IN BREAST CANCER

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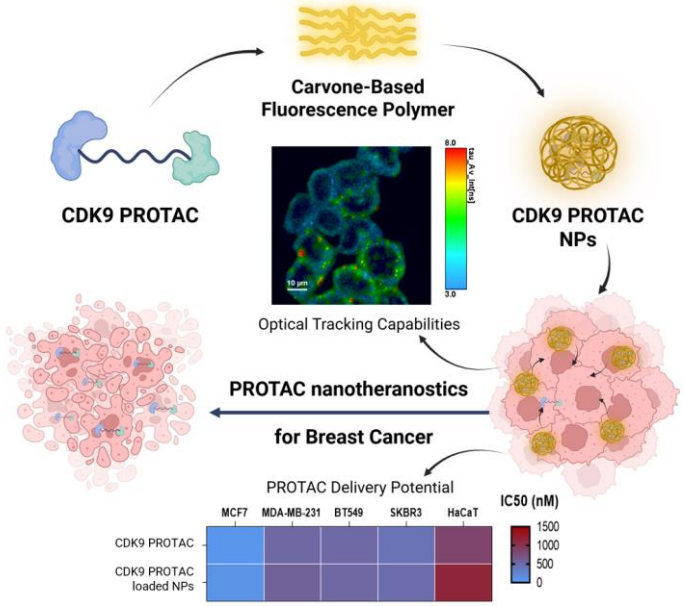
Targeted nanotherapies offer an effective strategy to enhance the therapeutic index of antitumour agents by improving efficacy while reducing systemic toxicity. We introduce a novel carvone-derived polyester synthesized via ring-opening copolymerization of cyclic anhydrides and epoxides as a sustainable nanodevice for the controlled delivery of new promising drug called proteolysis targeting chimeras (PROTAC). This biomass-derived copolymer exhibits nonconventional fluorescence arising from cluster-triggered emission (CTE) [1], letting intrinsic optical monitoring of nanoparticle (NP) behavior without external labels. Given these advantages, we aimed to assess the biomedical relevance of these fluorescent NPs using a therapeutically challenging molecule. We select THAL-SNS-032, a PROTAC degrader of Cyclin-Dependent Kinase 9 (CDK9), despite representing a paradigm shift in drug discovery by promoting targeted protein degradation rather than inhibition, often suffer from high molecular weight, poor solubility, limited cell permeability and toxic effect [2]. Encapsulation of THAL-SNS-032 within the carvone-based NPs preserved its cytotoxic potency while improving biocompatibility. Fluorescence Lifetime Imaging Microscopy confirmed efficient cellular uptake and time-dependent NP disassembly. Biological evaluation in breast cancer models showed comparable efficacy to the free PROTAC but reduced on-target/off-tumor toxicity in non-transformed epithelial cells. Overall, this work introduces a new class of renewable, self-fluorescent polyesters as multifunctional nanocarriers capable of integrating drug delivery and real-time imaging, establishing their potential for next-generation PROTAC nanotheranostics [3].



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O9 – NEAR-INFRARED OPTICAL WAVEGUIDES AND PHOTOPHYSICAL INSIGHTS ON THADIAZOLO-BENZOTRIAZOLE (BTD-BTZ) SYSTEMS

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In this work, a novel series of three 5*H*-[1,2,5]thiadiazolo[3,4-f]benzotriazole (**BTD-BTZ**) derivatives has been synthesized (Figure 1). The central core strategically combines benzothiadiazole (**BTD**) and benzotriazole (**BTZ**) moieties to achieve a red-shifted emission, resulting in fluorescence in near-infrared region (NIR). Additionally, these materials demonstrate promising optical waveguiding behavior in the NIR region with emission maxima higher than 800 nm for **BTD-BTZ2** and **BTD-BTZ3**, further highlighting their potential for advanced photonic applications (Figure 1).[1] To the best of our knowledge, these are the first reported instances of **BTD-BTZ** derivatives exhibiting such waveguiding capabilities within this spectral range. A comprehensive photophysical characterization, including solvatochromism and halochromism studies for **BTD-BTZ1**, is presented, alongside a comparative analysis of the three synthesized derivatives. Theoretical calculations were also performed to support experimental results. The exceptional emission properties and NIR waveguiding behaviour underscores the potential of these **BTD-BTZ** derivatives for cutting-edge applications in telecommunications, bioimaging, and optical sensing.

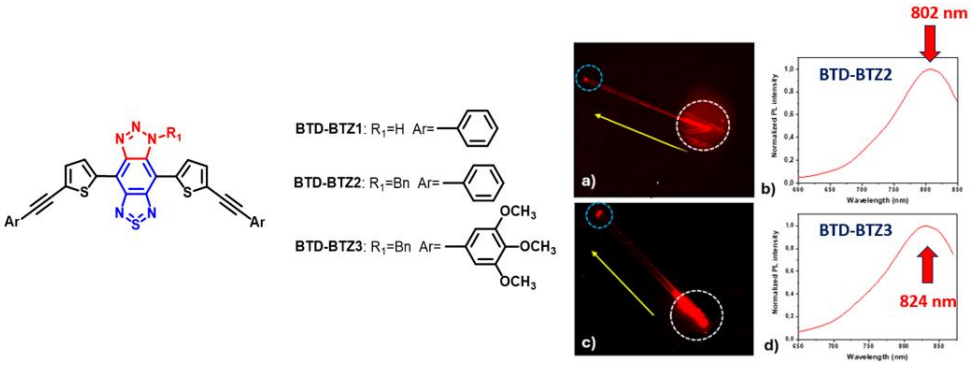

Figure 1. (left) **BTD-BTZ** derivatives, object of study in this work (Bn=Benzyl group). (right) FL images of crystals of a) **BTD-BTZ2** and c) **BTD-BTZ3**. PL spectra of crystals b) **BTD-BTZ2** and d) **BTD-BTZ3**. In images a) and c) white circles indicate the excitation point, blue circles the emission point and the yellow arrow the light propagation direction.

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O10 – NEW BIO-BASED NON-ISOCYANATE POLYHYDROXYURETHANES (NIPUs) FOR THE PREPARATION OF THERMOPLASTICS AND THERMOSETS

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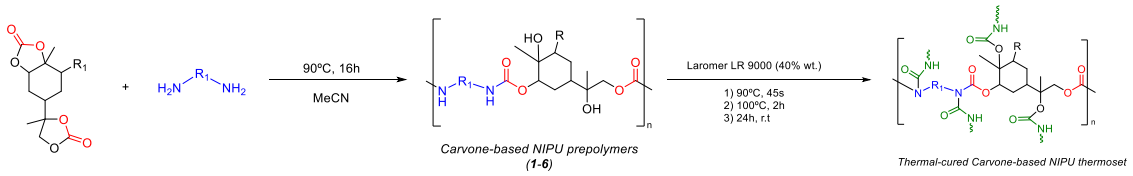
Polyurethanes (PUs) are versatile polymers widely employed across various industries due to their outstanding chemical, mechanical, and physical properties, including abrasion resistance, durability, low weight, and high tensile strength.[1] Consequently, PUs are utilized in numerous applications—such as adhesives, foams, fibers, paints, varnishes, and sealants—with global production exceeding 22 million tons in 2024.[2]

Despite the widespread use of polyurethanes (PUs), their traditional synthesis relies on toxic isocyanates and fossil-derived polyols. While the development of non-isocyanate polyurethanes (NIPUs)—specifically polyhydroxyurethanes (PHUs)—offers a safer and more sustainable alternative, the route still lacks sufficient renewable, bio-sourced monomer options.[3] To address this limitation, this study reports the synthesis of novel thermoplastic NIPUs through polyaddition reactions between a bio-based cyclic carbonate, carvyl acetate dicarbonate (CADC), and a range of commercial diamines (Scheme 1). The thermomechanical properties of these fully new bio-based materials were systematically evaluated to assess their potential industrial applications.



Scheme 1. Synthetic route for the preparation of NIPUs thermosets.

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O11 – BIO-BASED 1,3-DICARBONYL LIGANDS AND ALTERNATIVE COBALT PRECURSORS FOR TUNABLE RESIN CURING SYSTEMS

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Levulinic acid is a biomass-derived platform chemical produced from lignocellulosic residues through acid-catalyzed hydrolysis and subsequent dehydration processes. Its simple structure, bearing both ketone and carboxylic acid functionalities, enables straightforward chemical transformations into a wide range of value-added derivatives. In this context, levulinic acid represents a sustainable alternative to fossil-based feedstocks for the development of functional additives. In the resin industry, curing processes are typically based on a specific cobalt-based complex as catalyst and acetylacetone as promoter. Herein, we propose a redesigned catalytic system combining bio-based 1,3-dicarbonyl ligands derived from levulinic acid with an alternative cobalt precursor ($CoCl_2$). The synthesized ligands mimic the coordination properties of conventional promoters while introducing a renewable origin and enhanced structural tunability. Scheme 1 illustrates the general workflow for the synthesis and integration of the new promoters into the curing system.

Scheme 1. General procedure for the workflow of new promoters.

The combination of these new ligands with $CoCl_2$ generates catalytic systems with reactivity profiles ranging from slower to faster curing rates compared to the conventional cobalt precursor/acetylacetone benchmark. This approach enables fine control over the curing kinetics, offering a versatile tool for adapting resin formulations to emerging industrial requirements.

In parallel, this work also addresses the transition from traditional mineral fillers such as potassium feldspar towards safer alternatives, including micronized glass and glass frit, reducing the risks associated with respirable dust during processing.

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O12 – ACTIVATED CARBONS FROM BIOMASS FOR ELECTROCATALYTIC REDUCTION OF CO_2

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The extensive use of fossil fuels has significantly increased atmospheric CO_2 concentrations, driving climate change and the global energy crisis. Converting CO_2 into value-added chemicals (e.g., CH_4, CO, CH_3OH) via electrochemical processes offers a sustainable path toward decarbonization. However, high overpotentials and slow reaction kinetics remain major barriers to large-scale implementation. While noble metals like palladium (Pd) are effective, their high cost requires the development of affordable alternatives. Transition metal-based catalysts supported on porous carbon materials are promising due to their low cost, high conductivity, and availability. This study evaluates various activated carbons (ACs) synthesized from biomass including, starch (St) and chitosan (Q) as precursors. These materials were developed as electrocatalysts for both the oxygen evolution reaction (OER) and the CO_2 reduction reaction (CO_2RR). ACs were produced using $FeCl_3$, $ZnCl_2$ or a combination of both as activating agents. Additionally, ACs samples were modified with nickel to optimize their catalytic performance. Regarding precursors, starch-derived carbons developed greater microporosity, while chitosan-derived materials exhibited higher mesoporosity. Morphological analysis via SEM confirmed that Zn-activation produces irregular, highly porous structures, whereas Fe-activation results in more compact, laminar profiles (Figure 1).

Electrochemical performance for CO_2RR was evaluated using cyclic voltammetry (CV). Comparisons between N_2 and CO_2 atmospheres showed a different oxidation peak at approximately 0.85 V vs. RHE in the ring (associated with the oxidation of CO). Additionally, a peak is detected between 1.2 and 1.4 V, possibly related to the formation of CH_4.

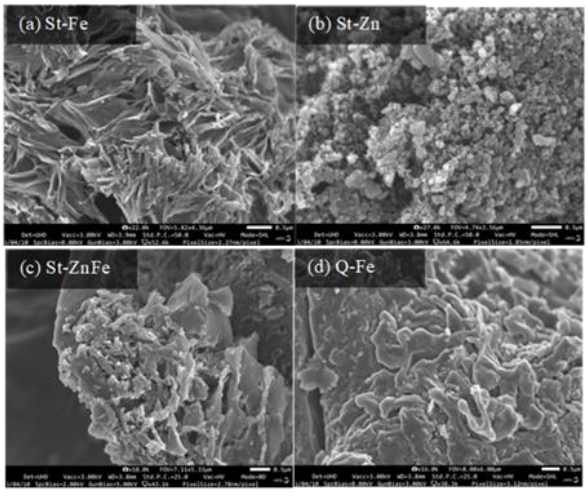

Fig. 1 SEM images of ACs prepared by chemical activation of starch (St) and chitosan (Q) as precursors.

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O13 – FUNCTIONALISATION OF IRON OXIDE CATALYSTS SUPPORTED ON BIOCHAR (FeOx@BIOCHAR) FOR WATER DECONTAMINATION

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Biochar is an effective adsorbent for water and soil remediation due to its porous structure, and the functional groups present on its surface, which enable it either to form complexes with pollutants or to participate in ion exchange with metals. However, its effectiveness is limited by its low specific surface area and the small number of oxygen-containing groups on the surface, which act as ligands [1]. To address this issue, the functionalisation of biochar with potassium hydroxide (KOH) is proved to increase the specific surface area, porosity and proportion of hydroxyl groups on its surface [2,3]. Additionally, functionalisation with potassium oxalate ($K_2C_2O_4$), improve and prolong the Fe^{2+}/Fe^{3+} redox cycles during the photo-Fenton process. Thus, the bidentate ferrioxalate mononuclear complex enhances the efficiency of these processes by preventing the precipitation of iron as hydroxide [4], regenerating the Fe^{2+} species, allowing the process to operate at circumneutral pH, and improving the production of reactive oxygen species (ROS).

Thus, our aim was to develop iron catalysts supported on biochar functionalised through treatment with KOH and $K_2C_2O_4$, to compare which of the two methods yields better results in terms of the degradation of emerging pollutants in water.

These FeOx@biochar functionalised catalysts were fully characterised, and their efficacy in the degradation of four pollutants, such as imidacloprid (IMI), acetaminophen (ACE), ciprofloxacin (CPX) and sodium diclofenac (DCF), was studied.Thus, X-ray diffraction (XRD) confirmed magnetite, hematite, and zero-valent iron phases after calcination. XPS analysis showed an increase in oxygen-content on the surface of the catalysts of 18% for BioFeKOH and 6% for BioFeOxa, compared with BioFe.

BioFe showed low adsorption for ACE and IMI, but moderate for DCF and CPX, while BioFeKOH significantly improved removal up to > 90 %. In photo-Fenton, BioFe achieved complete degradation within 10 min due to iron leaching and low pH; however, functionalised materials operate at neutral or circumneutral pH, without iron leaching, suggesting and heterogeneous mechanism.

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O14 – ALGAE-DERIVED BIOPOLYMER FILMS: A STRATEGY FOR THE DEVELOPMENT OF MULTIFUNCTIONAL BIODEGRADABLE MATERIALS

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Nowadays, there is a growing demand for new sustainable materials to replace conventional synthetic plastics. Current research focuses on developing biodegradable materials with enhanced environmental compatibility and multifunctional properties, expanding their potential in various sectors, such as food packaging, coatings, tissue engineering and biomedicine.

Algae constitute a source of numerous bioactive compounds, most notably proteins, polysaccharides, carotenoids, fatty acids, vitamins, and minerals. Specifically, algal proteins and polysaccharides can be used to obtain bioplastics with suitable physicochemical properties, offering significant advantages over petroleum-based alternatives [1]. Within the algae's protein fraction, biliproteins stand out; these micro- and macroalgal pigments exhibit high multifunctionality, combining antioxidant and antibacterial properties with potential use as natural colorants and fluorescent reagents. Consequently, they have multiple applications across food, cosmetics, and medicine sectors (including immunoassays, antioxidant and anticancer effects, FRET assays with antibodies, flow cytometry, single-molecule counting, and natural dyes, among others) [2].

Our research group has extensive experience in the extraction and characterization of algae-derived compounds, having implemented a sustainable methodology based on scalable membrane filtration processes. This approach facilitates the recovery of biliproteins and polysaccharides in sufficient quantities for their evaluation in bioplastic formation. Accordingly, bioplastic films have been obtained through a polymerization reaction between polysaccharides and proteins, utilizing calcium as a cross-linking agent and various plasticizers. The resulting films underwent physicochemically characterization and were used in preliminary food packaging trials to assess their efficacy in preservation and spoilage minimization. Key parameters evaluated included water adsorption capacity, mass transfer and permeability, thickness and its variation over time, mechanical properties, and morphological and optical characteristics (transparency-opacity). The results indicate that biodegradable films obtained through the polymerization of the protein-polysaccharide tandem from algae, represent a viable alternative to conventional plastics, providing a new strategy to mitigate the severe environmental pollution they cause.

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O15 – CARVONE-BASED POLYESTERS AS SMART POLYMERS FOR PHOTOTHERMAL IMAGING

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Smart polymers are materials capable of responding to slight external stimuli.[1] In recent years, the development of polymers whose luminescence properties are sensitive to single stimulus has attracted increasing attention. However, most smart luminescent polymers exhibit low biocompatibility and biodegradability, raising concerns about their long-term environmental impact, which is a major drawback. To address these limitations, biomass-derived molecules have been used as monomers for the synthesis of biopolymers. Although these materials typically display poor optical properties due to the absence of conventional chromophores, non-traditional intrinsic luminescence can arise from the clustering of moieties containing n or π electrons.[2]

In this work, new bioderived copolyesters were synthesized by ROCOP of cyclic anhydrides with monoepoxides derived from carvone.[3] These polyesters contain no traditional conjugated fluorophores; nevertheless, non-traditional intrinsic luminescence is observed and arises from n-π* and/or π-π* interactions that are sensitive to temperature (Figure 1). Furthermore, these polymers have potential applications as microscopic thermal sensors and their potential was demonstrated by imaging the 3D temperature gradient along an isolated Au nanoparticle irradiated similarly to those used in photothermal therapies.

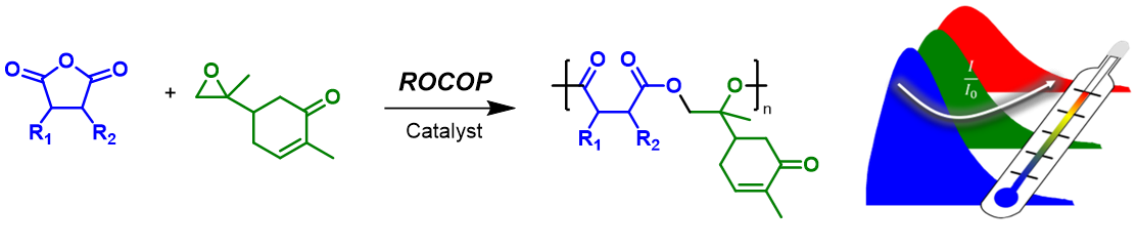

Figure 1.

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O16 – CARBON BASED BIFUNCTIONAL CATALYST FOR OXYGEN AND CO_2 REDUCTION REACTIONS

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In order to reach a sustainable future, it is pivotal to reduce our dependence on fossil fuels, as well as the reduction of the carbon footprint. To success in these objectives, major advances in the renewable energy industry and the management of CO_2 generated from fuel combustion are required. Devices such as fuel cells and electrolyzers play a key role in the new energy transition era. Fuel cells work as carbon-free and renewable energy producers, while electrolyzers consume this green energy produced in the conversion of CO_2 into value-added products. The major limiting factors in the implementation of these devices are the cathodic reactions of oxygen reduction (ORR) and CO_2 reduction (CO_2RR), respectively, as consequence of their high overpotentials, sluggish kinetics, and selectivity problems. Recently, carbon materials have emerged as cost-effective catalysts, particularly when they come from biomass waste. Furthermore, their tunable textural properties, can significantly enhance their catalytic performance when their structure is enriched with heteroatoms, such as B, N, P or S, and when they are used as supports of low metal loadings [1-3].

In this work, mango shell (MS) was used as biomass source and subjected to different treatments to obtain several activated carbons (ACs): M0, produced by pyrolysis; M1, activated with $FeCl_3$ and M2, activated with $FeCl_3$/$ZnCl_2$. Subsequently, M1 and M2 were doped with heteroatoms, yielding M3 and M4, respectively. In addition, M1 and M2 were doped with heteroatoms and used as supports for 2 wt. % of Co, Cu or Ni, obtaining the series of catalyst M3_X and M4_X, where the X denotes the supported metal. All the catalysts were thoroughly characterized by FTIR, Raman, N_2 and CO_2 isotherm adsorption, XRD, SEM, TEM, EA, ICP and XPS. Additionally, their catalytic activity was evaluated and electrochemically characterized using a three-electrode cell, using a RRDE (with a glassy carbon disk and a Pt ring) as a working electrode (WE), a Pt counter electrode (CE), and an Ag/AgCl reference electrode (RE).

The evaluation of the catalysts in both reactions shows the influence of the activation method in the results, as well as the positive effect of the doping process. Nonetheless, metal incorporation has a more effect on improving the selectivity. The mechanism of the ORR was determined using RRDE equation, while the identification of the products of the CO_2RR was realized by the oxidation of the products at RRDE's Pt ring. The electrochemical characterization of the selected materials included the determination of the electrochemically active surface area (ECSA), Tafel analysis, electrochemical impedance spectroscopy (EIS) and durability tests.

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O17 – ASSESSMENT OF REACTION MECHANISMS INVOLVED IN ZERO-VALENT IRON AND IRON OXIDE APLICATION IN HETEROGENEOUS PHOTO-FENTON TREATMENT

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Zero valent iron (Fe^0) and iron oxides (magnetite, Fe_3O_4; maghemite, γ-Fe_2O_3; and hematite, α-Fe_2O_3), have addressed significant potential application for the removal of biorecalcitrant organic pollutants by heterogeneous photo-Fenton processes [1]. However, their apparent catalytic efficiency is often strongly influenced by operational conditions, particularly optimal acidic pH conditions optimal for Fenton process, or by synergistic effects driven by supporting materials or dopants. Consequently, the intrinsic reactivity of these iron-based materials in their pure form remains insufficiently understood. Among iron oxides, the structure γ-Fe_2O_3 contains exclusively Fe (III) ions, like α–Fe_2O_3, although ion distribution and magnetic properties are more like in Fe_3O_4; thus, γ-Fe_2O_3 is frequently described as a transitional phase between Fe_3O_4 & α-Fe_2O_3 [2]. The main objective of this research work was to assess and compare the performance of three commercial iron-based catalysts (Fe^o, Fe_3O_4, & α-Fe_2O_3) and one synthesized maghemite (γ-Fe_2O_3, T=400 °C) for the degradation of acetaminophen (ACE, 10mg·L^{-1}) by the heterogeneous photo-Fenton treatment. Dominant reaction mechanisms under both acidic and circumneutral pH conditions are herein addressed. X-ray diffraction (XRD) analysis verified the purity of the commercial catalysts. The synthesized γ-Fe_2O_3 exhibited diffraction patterns closely resembling α-Fe_2O_3, suggesting partial phase transformation during calcination. This behaviour may be attributed to the textural characteristics of the Fe_3O_4 precursor, which may modify T range for pure γ -Fe_2O_3 synthesis [3]. All pure iron oxides displayed limited adsorption capacity because of their low S_{BET}; but Fe^o addressed remarkable adsorption capacity under acid pH. Full ACE removal (X = ($[ACE]_0$-[ACE])/$[ACE]_0$, %) was addressed by Fe^0-assissted photo-Fenton process in less than 20 minutes of treatment under acid pH values, followed by Fe_3O_4 (X = 94 %), γ-Fe_2O_3 (X = 82 %) and α-Fe_2O_3 (X = 48%) after 5 hours of reaction. Under circumneutral initial pH values of the ACE solution (pH ≈ 6.5), Fe^0 also addressed superior performance (X = 86%), whereas iron oxides contributed to lower treatment efficiencies, that were, X = 61%, 34%, and 24% for Fe_3O_4, α-Fe_2O_3, and γ-Fe_2O_3, respectively. The observed degradation can be attributed to a combination of reaction pathways promoted by different oxidizing agents, including hydroxyl radical (HO•), electron holes (h^+), and superoxide radical (O_2^{-}•), which are likely to operate simultaneously, promoting further pollutant conversion. HO• was addressed as the main oxidizing agent in all cases, whereas O_2^{-}• addressed a significant contribution under acid environments and h^+ under circumneutral ones. Iron leaching was only significant for the Fe^o system under acid pH values ([Fe]=26.3 mg L^{-1}), indicating key contribution of homogeneous Fenton reaction. Despite the reported high pollutant removal results, mineralization always remained below 5%, suggesting accumulation and possible recombination of intermediate by-products along treatment.

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O18 – CHROMIUM-BASED CHIRAL EMITTER ELECTROSTATICALLY ANCHORED ON MoS_2 FOR SPINTRONIC AND CHIROPTICAL APPLICATIONS

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The induction of chirality in optically and electronically active materials is of great interest for applications in sensing and quantum information transmission. Two-dimensional (2D) materials, such as transition metal dichalcogenides (TMDs), exhibit exceptional electronic and optical properties but are inherently achiral. In particular, molybdenum disulfide (MoS_2) has attracted considerable interest due to its unique properties when it is exfoliated into ultrathin flakes, including its direct bandgap semiconductor nature, high flexibility, and tunability. These characteristics significantly enhance its potential applications in optoelectronics and spintronics.[1]

Due to their high aspect ratio and planar morphology, the preparation of chiral 2D nanomaterials could open new opportunities for the development of chiroptical sensors, materials for valleytronics, and other emerging applications. Moreover, chirality plays a fundamental role in numerous chemical and biological systems, making this research highly relevant to fields such as nanobiotechnology, nanomedicine, and nanotoxicology.[2], [3]

Recently, we have functionalized MoS_2 layers with simple cysteine chiral molecules by different approaches, probing the optical activity of the resulting composites. One step forward, MoS_2 was electrostatically functionalized with a positively charged chiral chromium complex with long-lived circularly polarized luminescence that displays strong dual light emission,[4] yielding a composite that exhibits a strong circular dichroism signal. After confirming the material's stability and chirality, preliminary magnetic conductive atomic force microscopy (mC-AFM) measurements enabled us to investigate the Chiral-Induced Spin Selectivity (CISS) effect.

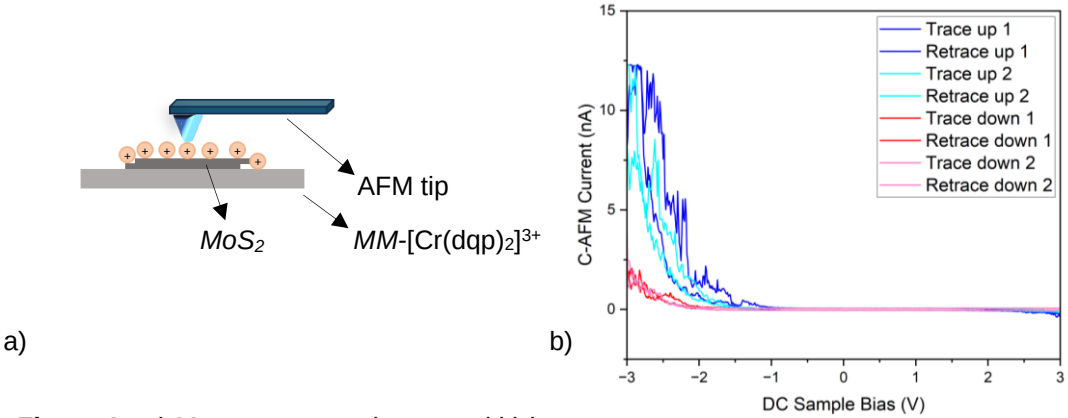

Figure 1.- a) Measurement scheme and b) its preliminary mC-AFM measurements while performing up-down-up-down magnetization cycles for the *MM* enantiomer.

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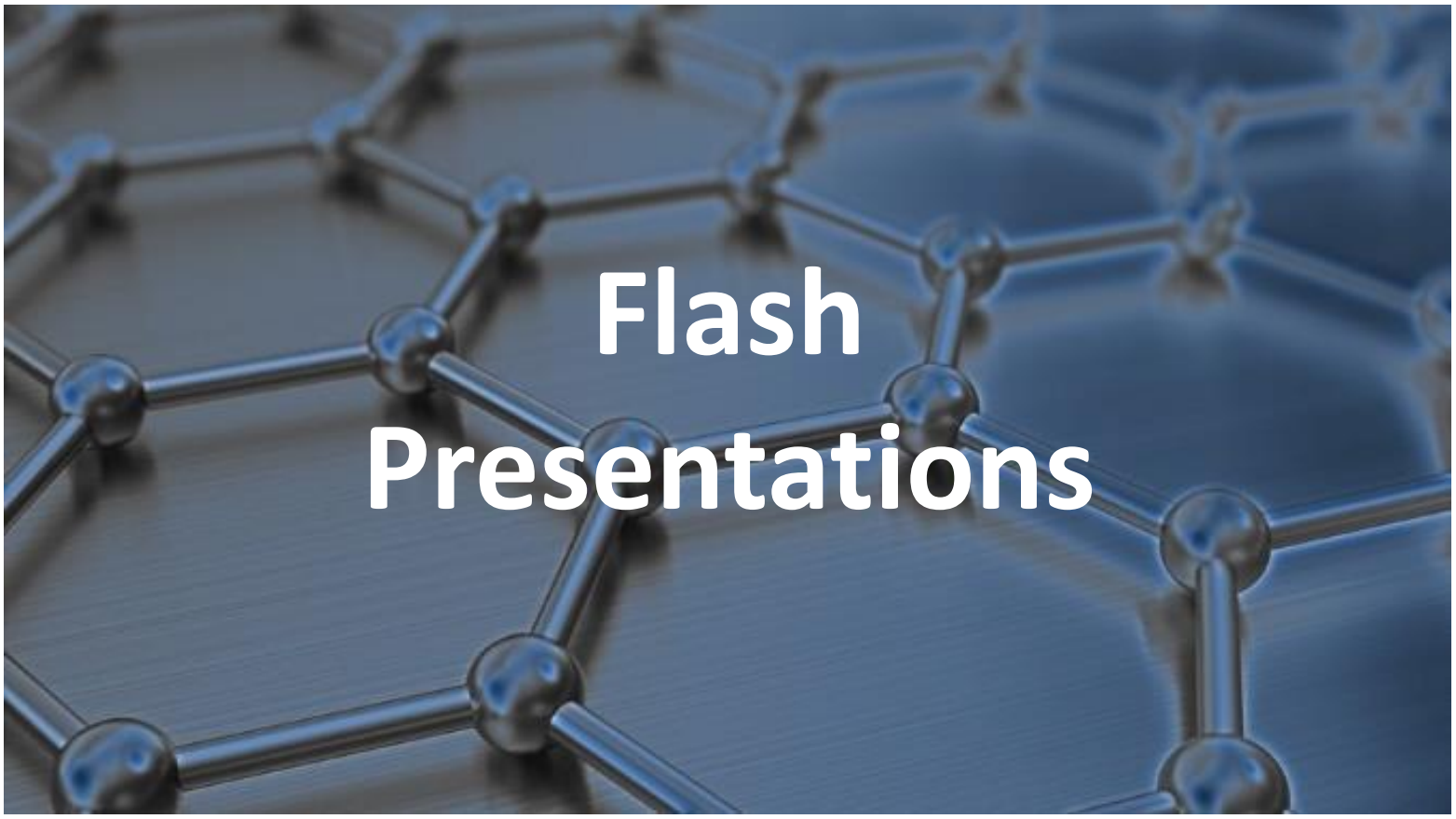

Flash Presentations

F1 – NOVEL PHOSPHONATE-BASED MOFs WITH POTENTIAL ELECTROCATALITYC ACTIVITY

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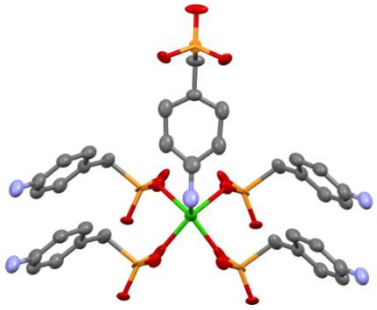
Currently, environmental sustainability and energy management stands as two of the most critical challenges facing societal development. The extensive use of fossil fuels, although still predominant, is not a viable long-term solution, as these resources are finite and will eventually be depleted. Moreover, their use is responsible for a significant part of global environmental pollution [1]. Consequently, current research efforts are increasingly focused on the development of sustainable systems for both energy storage and conversion. However, the key reactions involved in these systems (HER, OER, ORR, CO_2RR, etc.) exhibit slow kinetics, making the use of efficient catalysts essential for their practical implementation [2].

In this context, we propose the development of phosphonate-based metal–organic frameworks (MOFs) as potential electrocatalysts for these reactions. MOFs are an outstanding class of crystalline materials based on metal ions or clusters coordinated to organic ligands, leading to a potentially porous structure. In this work, the design of MOFs is based on the conceptual selection, focusing on the meticulous choice of linkers and metals as building blocks to be used in structuring new MOFs. From the coordination point of view, phosphonate-based ligands are preferred as they are known for their, a priori, higher stability due to the stronger covalency of the P-O bond, leading to robust structures [3], [4]. From the chemical point of view electroactive metals (Cu, Co, Mn, and Fe) have been selected, due to their accessible redox states, which facilitate electron transfer processes. Here, we present three novel and highly robust MOFs based on Cu, Co, and Mn and the 4-aminobenzylphosphonic acid (H_2ABPA) linker (Figure 1). The crystal structures and detailed characterization of these materials are presented and discussed. Their outstanding chemical and structural stability under harsh conditions (pH 2,5 to 10,5), makes these materials an excellent choice to be used as electrocatalyst in energy storage and conversion reactions.

Figure 1. Copper coordination environment in the Cu–ABPA material.



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F2 – MODULAR THERMOCHROMIC POLYMERS FOR PASSIVE COLORIMETRIC TEMPERATURE SENSING

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Temperature monitoring is crucial in multiple applications such as smart packaging and industrial safety. In this context, achieving accurate measurements under diverse conditions in a cost-effective, and sustainable manner remains a key challenge for both the scientific community and industry. Conventional temperature sensors commonly rely on electronic components and external power sources, however, the current life cycle model of electronic products (involving production, consumption, and disposal) is not sustainable in the long term. In this context, colorimetric sensors emerge as a sustainable, flexible, and low-cost alternative, capable of converting physicochemical variations into easily interpretable optical signals [1]. This communication reports a fully passive colorimetric temperature sensor based on a polydimethylsiloxane (PDMS) matrix functionalized with reversible thermochromic pigments [2]. The sensing platform employs a modular design based on six independent PDMS-based elements incorporating blue and red thermochromic leuco dyes with distinct activation temperatures (Figure 1), enabling a continuous temperature response between 7.8 °C and 36.6 °C. The system can be readily scaled or adapted by selecting pigments with different transition thresholds. PDMS ensures biocompatibility, optical transparency, elasticity, and mechanical stability, facilitating integration onto flat or deformable surfaces. Structural, optical, and thermal characterization demonstrates stable, reproducible responses with low hysteresis over multiple heating and cooling cycles. Together with digital image analysis and machine-learning-assisted color quantification, this multifunctional material offers a sustainable solution for real-time thermal monitoring and paves the way for integration into smart packaging and colorimetric QR codes.

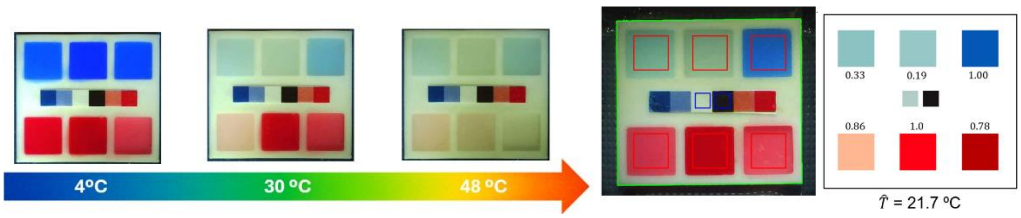

Figure 1. Thermochromic response of the full sensor module and digital interpretation.

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F3 – FROM DISCRETE MONOMERS TO COORDINATION POLYMERS: A THIOL-ENE PHOTOPOLYMERIZATION STRATEGY FOR MULTIFUNCTIONAL MATERIALS

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Coordination polymers (CPs) represent a versatile platform for developing multifunctional materials due to their diverse properties, such as magnetic and luminescent ones, enabling applications in fields like information storage[1] and chemical sensing.[2] Lanthanide based CPs are particularly interesting due to their favorable magnetic and luminescent properties. Traditionally, these CPs are obtained by coordination-driven self-assembly. However, in recent years, there has been a growing interest in developing alternative methods to obtain the CPs such as thiol-ene “click” reactions for monomer to polymer conversion.[3]

In this communication, we report a novel monomeric precursor compound synthesized from the macrocyclic ligand H_4L (cyclam derivative), succinic acid and 3-butenoic acid (3-BA). The structural characterization reveals the following formula: $[Zn_2(\mu\text{-}H_2L)_2(\mu\text{-succinate})Eu_2(3\text{-}BA)_2](OTf)_2$ (**1_{Eu}**). The presence of the 3-BA ligand allows the formation of a CP through a thiol-ene “click” reaction as proposed in **Figure 1**. Looking forward, our next objective is to enhance the chiroptical response of the system by replacing the succinic acid with enantiopure R/S-methylsuccinic acid, increasing the overall chirality of the structure and potentially boosting its circularly polarized luminescence (CPL) signal. Additionally, we aim to extend this strategy to other lanthanide ions, such as Dy(III), to explore the magnetic properties.

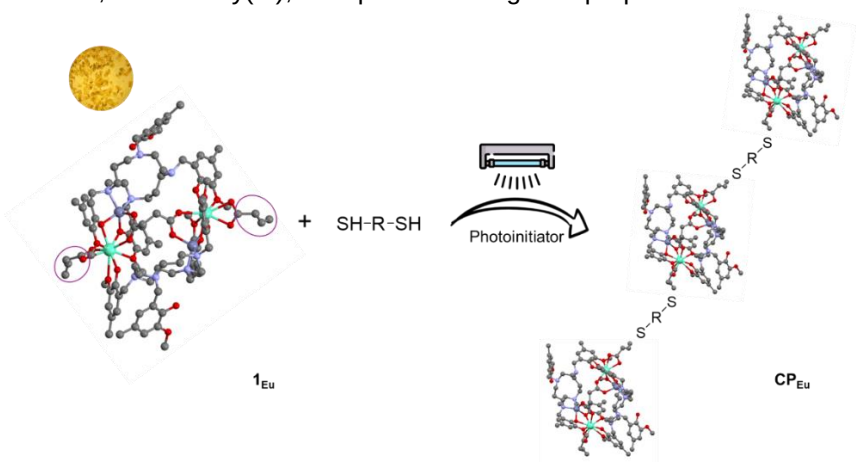

Figure 1. Crystal structure of compound **1_{EU}** and graphical representation of the proposed “click” reaction to obtain CPs.

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F4 – INSIGHTS INTO THE ROLE OF CO-LINKER MODULATION ON THE STRUCTURE, PROPERTIES, AND BIOACTIVITY OF AGROMOFS

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Agrochemicals play a key role in modern agriculture by supporting the increasing demand for food worldwide. Nevertheless, their extensive application and limited selectivity have resulted in serious environmental issues, raising concerns about the long-term sustainability of current agricultural practices. This challenge highlights the necessity of developing safer and more sustainable strategies. In this regard, Metal–Organic Frameworks (MOFs) have attracted considerable attention as versatile materials with potential uses in agriculture, including water treatment, controlled agrochemical delivery, and sensing applications. [1,2]

Over the past few years, our research group has introduced a new type of MOFs, named AgroMOFs, in which bioactive agrochemicals are directly incorporated as building units of the framework. A notable example is GR-MOF-20, $[Cu_3(H_2Gly)_2(4,4'\text{-Bipy})_2]\cdot 12H_2O$, constructed from the flexible herbicide glyphosine (H_5Gly), 4,4′-bipyridine (4,4′-Bipy) as a co-linker, and Cu^{2+} ions, which are well known for their antibacterial and fungicidal properties. This material has shown a synergistic effect, displaying both herbicidal and antibacterial activity against relevant wheat threats, such as the invasive weed *Lolium multiflorum* and the resistant bacterium *Pseudomonas syringae*. [3]

In this work, we aim to expand the functionality of AgroMOFs by not only integrating active ingredients into the framework, but also enabling their incorporation within the porosity of the material. To achieve this, we explore the effect of co-linker substitution on the resulting structure and porosity. Thus, two new isomeric AgroMOFs, GR-MOF-40 and GR-MOF-41, with formulas $[Cu_3(H_2Gly)_2(4,4'\text{-Azopy})_2]\cdot nH_2O$ (n = 6–28) and $[Cu_3(H_2Gly)_2(4,4'\text{-Azopy})_2]\cdot 3H_2O$, respectively, were successfully synthesized and fully characterized by single-crystal and powder X-ray diffraction. GR-MOF-40 was obtained by replacing the co-linker in GR-MOF-20 with 4,4′-azopyridine, leading to a structural analogue, whereas GR-MOF-41 was isolated as a polymorph under modified synthetic conditions.

Importantly, GR-MOF-40 exhibits enhanced CO_2 adsorption compared to GR-MOF-20, supporting an increase in accessible porosity. This result serves as a proof of concept for the potential incorporation of additional active ingredients within the pores of the material, opening the door to multifunctional AgroMOFs with dual activity: intrinsic bioactivity from the framework and cargo delivery from the internal porosity. Furthermore, preliminary studies confirm that these materials retain significant herbicidal and antibacterial activity.

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F5 – 2-HYDROXYNICOTINATE AND TEREPHTHALATE LIGAND-BASED METAL ORGANIC FRAMEWORKS (MOFS): AN INSIGHT INTO THEIR PHOTOLUMINESCENCE EMISSION AND DETECTION CAPACITY

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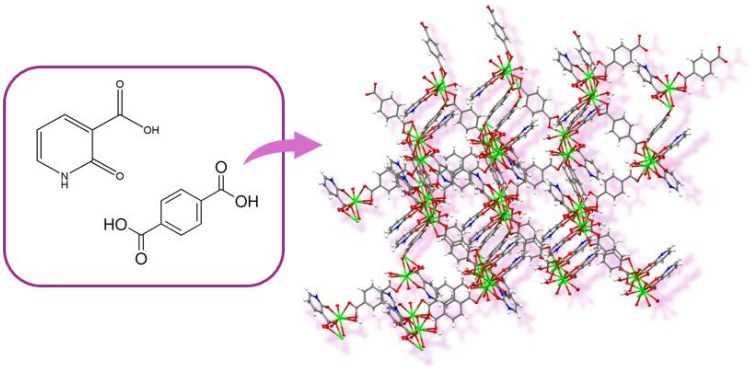
Coordination polymers (CPs) and their subclass, metal-organic frameworks (MOFs), have attracted increasing interest due to their structural and chemical versatility. These characteristics result from a rational design that allows for endless combinations of metal centres and organic ligands to achieve desired functional properties.[1]

In this communication, we present the synthesis and characterization of a family of isostructural MOFs of general formula $\{[Ln(2onic)(TP)(H_2O)]\cdot 4H_2O\}_n$ (where Ln(III) = Nd (**1**$_{Nd}$), Eu (**2**$_{Eu}$), Gd (**3**$_{Gd}$), Tb (**4**$_{Tb}$) and Dy (**5**$_{Dy}$), 2onic= 2-hydroxynicotinate and TP = terephthalate). The synergy between the ligands creates a three-dimensional framework with high chemical and optical stability, which is expected to provide a highly interesting structure for functional applications.

Taking advantage of the well-known emissive properties of lanthanide ions and their potential sensitization by the selected antenna-like ligands, the photoluminescent properties of these compounds have been evaluated. Given the intense emission and stability observed in related systems,[2],[3] we anticipate a high sensitivity and selectivity for the photoluminescent detection of critical analytes, including environmental pollutants (pesticides), healthcare-related molecules (antibiotics and biomarkers), and hazardous volatile organic compounds (VOCs). This study aims to demonstrate the versatility of these multifunctional materials with potential applications in lighting and chemical sensing.



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F6 – NOVEL PHOTOSENSITIZERS FOR SAFER AND MORE EFFECTIVE PHOTODYNAMIC THERAPY

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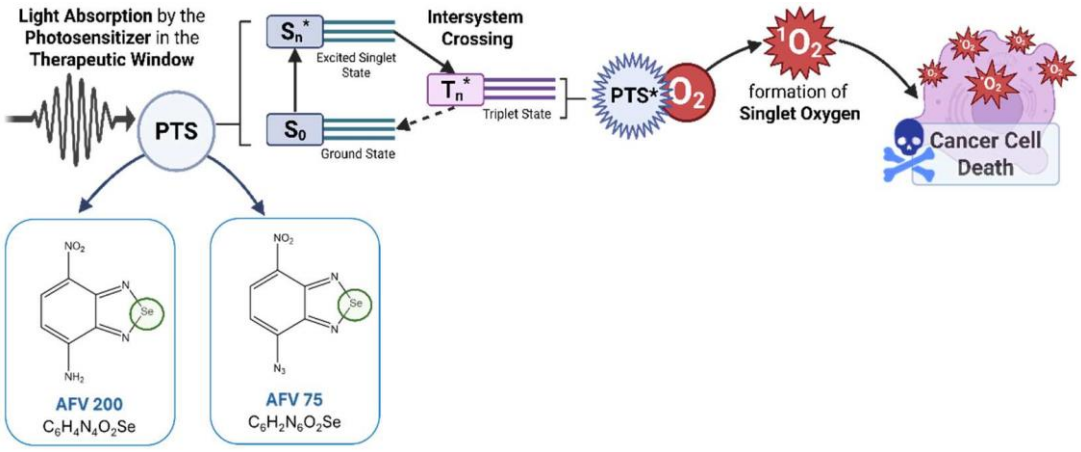
Photodynamic therapy (PDT) is a medical treatment that uses a combination of a light-sensitive molecule, called a photosensitizer (PTS), and visible light to selectively destroy cancer cells. After the photosensitizer is administered and accumulates in the target tissue, the area is illuminated with light. This light excites the photosensitizer, which then transfers energy to oxygen naturally present in the cells. As a result, highly reactive forms of oxygen are produced (Singlet Oxigen), which can damage and kill the unwanted cells while sparing much of the surrounding healthy tissue [1][2].

In our work, we explore a new family of molecules called benzoselenadiazole derivatives (AFV compounds) as potential photosensitizers for PDT. These molecules contain selenium, an element that helps them reach an excited state more efficiently and produce larger amounts of activated oxygen when exposed to light. We focus on how well these compounds absorb visible light in a range suitable for treating superficial tumors, such as certain types of skin cancer, and on how effectively they generate singlet oxygen [2].

The advantage of these AFV derivatives is that some of them include a guanidinium group, which makes them more soluble in water and therefore easier to handle in biological environments. Overall, our results suggest that selenium-containing benzoselenadiazole derivatives are strong candidates for safer and more effective PDT and provide a solid basis for future biological and cytotoxicity studies.



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F7 – POROUS COORDINATION POLYMERS FOR WATER HARVESTING APPLICATION

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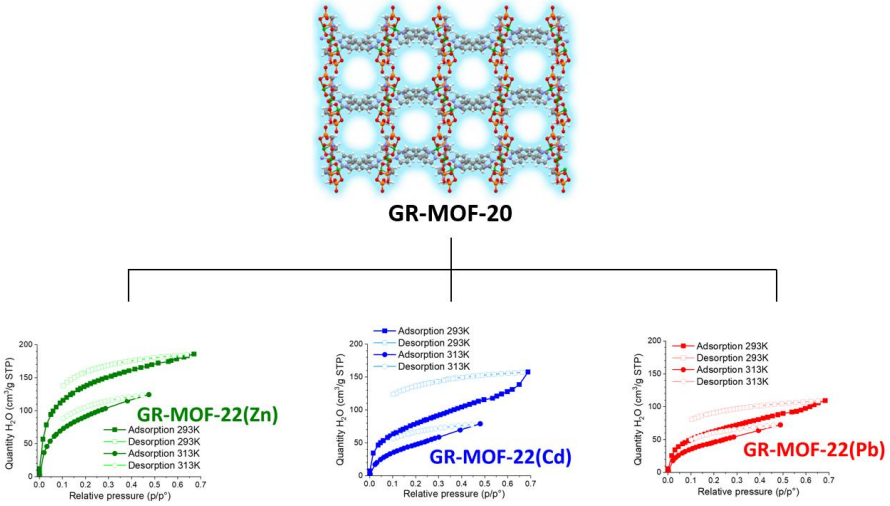
It is estimated that more than 5 billion people will live in water-stressed regions by 2050. Furthermore, more than half of global food production will be at risk due to the high-water demand. Therefore, it is necessary to develop alternative strategies to mitigate these impacts and prevent these scenarios. Fortunately, there is a potential solution to mitigate this problem, as significant amounts of water can be harvested from the air. In this context, porous coordination polymers (PCPs), also known as Metal-Organic Frameworks (MOFs), are materials that have emerged as an exceptional class of crystalline coordination polymers with exceptional structural tunability, large surface area and high porosity [1]. MOFs present some cavities in their structure which enable the sorption of atmospheric water. Herein, our group has recently synthesized a new 2D porous coordination polymer, named GR-MOF-20, based on copper and the flexible ligand glyphosine (H_5Gly) and 4,4'-bipyridine [2]. As a further step in the discovery of novel materials, three new post-synthetic MOFs, named GR-MOF-22(M) (M = Zn, Pb and Cd) have been obtained via post-synthetic modification of GR-MOF-20. Their capacity to capture water within the cavities has been evaluated through water adsorption isotherms and compared with the pristine GR-MOF-20. The best-performing materials in terms of water uptake will be further evaluated in water harvesting under simulated day/night conditions at different relative humidity values (32, 53 and 75%) at room temperature for adsorption (night) and under solar heating conditions for desorption (day). The experiments will be carried out in cycles to assess reproducibility and stability during water sorption, in order to evaluate the recyclability of the materials.



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F8 – PHOTOCONDUCTIVITY AND CHARGE-TRANSFER EFFICIENCY IN METAL-FREE g-C_3N_4/PEDOT:PSS HYBRID THIN FILMS

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Metal-free hybrid materials that integrate conductive polymers with visible-light-responsive semiconductors represent an attractive strategy for advancing sustainable photoelectrochemical technologies. In this study, we fabricated and characterised PEDOT:PSS-based thin films modified with graphitic carbon nitride (g-C_3N_4), a non-metallic semiconductor obtained through melamine pyrolysis. The hybrid films were prepared via spin-coating, changing the g-C_3N_4/PEDOT:PSS ratios and employing two fabrication methods based either in mixed or multilayer systems. Their surface morphology and the distribution of g-C_3N_4 nanosheets were characterised using AFM, while UV-Vis spectroscopy provided information on their optical behaviour and allowed the estimation of their band gaps.

Chopped-light chronoamperometry confirmed that the incorporation of g-C_3N_4 significantly enhances the photoconductivity of PEDOT:PSS-based films, resulting in a higher photo-induced currents due to more efficient charge-separation. Of all the evaluated configurations, the multilayers exhibited the strongest photocurrent response.

Furthermore, Nyquist plots were obtained via electrochemical characterisation by impedance spectroscopy (EIS), allowing a comparison of the charge transfer resistances (R_{ct}). This value was found to be lower in the multilayer systems. Additionally, the equivalent circuit corresponding to each system could be determined.

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